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VERTEBRATE PEST INFESTATIONS IN PASSCO GRAIN STORAGE CENTRES

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Abstract.- We surveyed 56 indoor godowns at 21 PASSCO grain storage centres in Punjab and examined 90 outdoor plinths at 25 centres on which bagged wheat was stored under tarpaulins. Vertebrate pest (mostly rodents and birds) infestations were seen at 22 of the 56 godowns and at all of the 90 plinths examined. Only 4 godowns were rodent infested, while at 90 outdoor plinths, 72 were infested. Outdoor storage areas were infested by Indian gerbil (*Tatera indica*), house mouse (*Mus musculus*), desert jird (*Meriones hurrianae*), short-tailed mole rat (*Nesokia indica*), lesser bandicoot rat (*Bandicota bengalensis*), roof or house rat (*Rattus rattus*) and soft-furred field rat(*Millardia meltada*). Wild boar damage was noted at 2 plinths. Bird infestations occurred at 21 of the 56 godowns visited and at all 90 of the outdoor storage plinths. Structural condition of 89% of the godowns was judged as having good and 11% as fair. Mean age of godowns was 8 years. Structural defects were found in 41% of the godowns. Defective walls were the most frequently noted problem, followed by defective doors. Leaking roofs or broken windows were not seen in any godowns. In indoor storage, PASSCO godowns had much less problem with rodents than did the Punjab Food Department in the same type of structure. Vertebrate pest infestations in outdoor storage, however, were severe in a few cases and here significant grain losses were occurring.

INTRODUCTION

The Pakistan Agricultural Storage and Services Corporation Limited (PASSCO), a semi-autonomous agency, procures and stores wheat that is later distributed to NWFP, Balochistan, Azad Jammu and Kashmir (AJK) and the Pakistan Armed Forces. PASSCO's main procurement and storage facilities are in the Punjab, with a few centres in other provinces. The total indoor storage capacity in all of Pakistan is 312,000 mt out of which 2,77,000 mt is stored in Punjab. Due to shortage of godowns for storage, wheat sometimes is stored temporarily outdoors under tarpaulins on the plinths. In these centres, wheat is stored in bags and rarely, at some places, in bulk. The bags in these outdoor centres are stored on plinths raised 2 feet above the ground level and filled with soil at the bottom, while on top a 6 inch layer of sand. At some places the plinth height is only 6 inches above the ground.

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The PASSCO-design godown has a rodent-proof collar around the perimeter of structure. This collar is an extension of the floor so that a shelf of smoothed concrete protrudes approximately 30 cm outward from the entire structure and is about 1 m above the ground level (Fig 1). PASSCO has a Pest Control Wing , under the direction of the General Manager, Pesticide. This Wing procures pesticides for PASSCO and provides pest control training to the technical staff routinely at each storage centre. One of the objectives of this survey was to examine the storage facilities especially outdoor stocks to see if they were more vulnerable to rodent and bird infestation than indoor stocks. Another purpose of this survey was to compare PASSCO-designed grain storage structures or godowns for structural defects and vertebrate pest infestations with those of the Punjab Department of Food's (PDF) storage centres, since both are located in the same geographic areas.

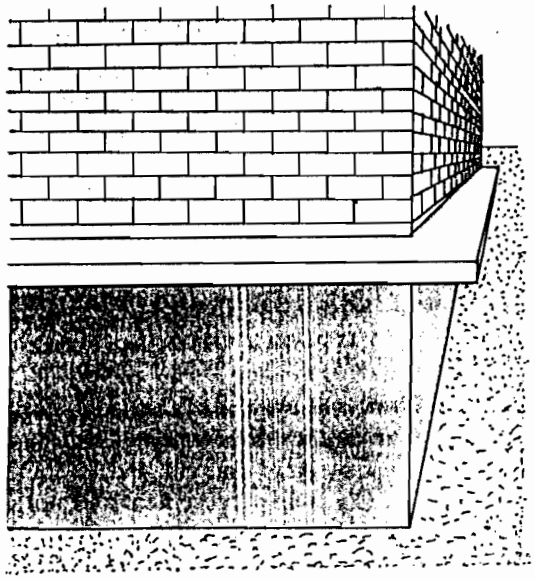

FIG. 1. PASSCO-type rodent guard.

METHODS

A complete listing of wheat storage centres was obtained from PASSCO officials in Lahore. This listed 28 centres in Punjab in which wheat was stored in godowns. Twenty one (75%) indoor wheat storage centres under PASSCO in Punjab were surveyed for vertebrate pest infestations. In these 21 centres 56 (20%) out of 277 house-type godown structures were physically inspected. The

interview and inspection procedure used was as previously described by Brooks and Ahmad (1986a). All godowns visited were physically inspected for structural condition (graded as good, fair, poor), structural defects, evidence of rodents, birds and their infestations (graded as severe, medium, few) and other vertebrate as described by Brooks and Ahmad (1986a).

During this survey 25 outdoor storage centres were visited. In these centres, 90 plinths were inspected for vertebrate pest infestation. In 88 out of the 90 plinths, wheat was stored in bags covered with tarpaulins while in the remaining 2 plinths (especially constructed by concrete, coal and tar on experimental basis) wheat was stored in bulk covered with water proof sheets of polythene material. At outdoor sites, the presence and density of rodents (burrows, droppings, live or dead animals) and birds (number seen visiting stacks, feeding on spilled grain, bird droppings on bags or plinths) were noted. This survey was conducted in November 1986.

RESULTS

A. *Indoor Storage*

In all house-type godowns wheat was stored in bulk, padded by a wall of bags. At the time of this survey, 85,445 mt wheat was stored in the 56 structures surveyed which was 30.8% of the total capacity of 277,000 mt in Punjab under PASSCO.

Storage Capacity and Sample Size

Storage capacity of PASSCO storage centres varied from 2,000 to 20,000 mt. At least two thirds of the sites of each category were surveyed for vertebrate pest infestations (Table I).

TABLE I.- STORAGE CAPACITIES AND NUMBER OF SITES VISITED

Capacity (mt)	No. of Centres	Centres Surveyed
Upto 4000	10*	6
4000-8000	5	5
8001-12000	3	2
12001-16000	6	4
16001-20000	5	4

* Wheat was stored in 9 centres at the time of survey.

Age and Structural Condition

Structural condition, as judged from the outside of the 56 godowns, was good in 50 (89.3%) and fair in 6 (10.7%) godowns. No godown was observed in poor condition. Godowns were approximately 8 years old, ranging from 4 to 10 years.

Structural Defects

Structural defects were noted in 23 godowns (41%) out of 56 surveyed. Defective walls were the most frequently noted defects present in 17 godowns (30%), followed by defective doors in 10 godowns (17.8%) and broken floors in 1 structure (1.8%). Leaking roofs or broken windows were not seen in any of the godowns visited.

Vertebrate Pest Infestations

Vertebrate pest infestations were noted in 22 godowns (39.3%) of the 56 checked (Table 2). Out of these 22 godowns birds infestations, mostly house sparrow (Passer domesticus) and sometimes pigeons (*Columba livia*) were noted in 21 godowns (37.4%). In all the godowns the severity of infestation was "few". Evidence of bird infestation was mostly droppings but sometimes live or dead birds and their nests were also observed in the godown.

Rodents were not frequent in PASSCO wheat storage centres being noted only in 4 godowns (7.1%) with the severity of infestation being "few" in each case. The house mouse (*Mus musculus*) in 3 godowns. The shrew (*Suncus murinus*), an insectivore was found in one godown along with house mouse. Roof rat and house mouse was found in another, while in 2 godowns only one rodent species was found. Evidence of rodent infestation was either droppings or dead animals found in the godown.

Pest Control Methods

The godown was cleaned and white washed before placing wheat in storage. The godowns are inspected for insect infestation one to three times a week after storage. If insects appear than "Actellic" (pirimiphos methyl) is sprayed. If "Actellic" does not control the insect infestation the grain is then fumigated with phosphine.

B. *Outdoor Storage*

Vertebrate Pest Infestations

Vertebrate pest infestation was noted in all the plinths inspected (Table 3). Birds were the major pests in all the plinths. Rodent infestations were found in 72 plinths (80%). Infestations by a single rodent species were noted in 68 plinths

(75.5%) and in 8 plinths (8.8%) two rodent species were found. *M. musculus* with *T. indica* were noted on 2 plinths, with *N. indica* on 2 and with B. bengalensis on 2 plinths while in 2 plinths N. indica with *T. indica* were observed.

TABLE II: VERTEBRATE PEST INFESTATIONS IN GODOWNS.

No. of godowns visited 56		
No. of godowns with vertebrate pest infestations		22
Bird infestations		21
Rodent infestations:		
House mice		2
Roof rat		3
Shrew infestations		1
Severity of infestations		
Birds:	Few	21
	Medium	0
	Severe	0
Rodents:	Few	4
	Medium	0
	Severe	0

Evidence of rodent infestations was a) fresh or old burrows in 58 (64.4%), b) droppings in 10 (11.1%), c) live animals in 9 (10%) and d) dead animals in 9 (10%) plinths. Number of burrow openings around individual plinths varied from 1 to 28 burrows.

Wild boar damage was found at 2 plinths with 6 and 8 bags were damaged at each. Although porcupine damage was claimed at 2 sites, it was not observed in our survey.

Bird infestations were noted as "severe" at 3 (3.3%) plinths and were "few" at 87 (96.7%) plinths. In most cases birds were feeding spilled grain, house sparrow, pigeon and occasionally, common mynas were the birds involved. All cases of "severe" infestations were due to pigeons.

DISCUSSION

A. *Indoor Storage*

General Maintenance and Structural Conditions

In the 21 centres surveyed, 20% of the godown structures were physically inspected and the structural condition of 89% was good, which indicates that

PASSCO has maintained these structures properly. PASSCO has its own maintenance and engineering wing which is responsible for repair of structural defects and maintenance of godowns. For this reason, the kinds of structural defects noted during this survey ran only 0.5 per godown.

TABLE III.- VERTEBRATE PEST INFESTATION IN OUTDOOR PLINTHS

No. of plinths inspected	90
No. of plinths with vertebrate pest	90 (100%)
Bird Infestations	90 (100%)
Rodent Infestations	72 (80%)
Tatera indica	26 (28.8%)
Mus musculus	16 (17.7%)
Meriones hurrianae	9 (10.0%)
Nesokia indica	8 (8.8%)
Bandicota bengalensis	6 (6.6%)
Rattus rattus	2 (2.2%)
Millardia meltada	1 (1.1%)
Other vertebrates (only Wild Boar)	2 (2.2%)
Severity of Infestation:	

	Birds	Rodents
Few	87 (96.7%)	53 (58.8%)
Medium	-	16 (17.7%)
Severe	3 (3.3%)	3 (3.3%)

This was in sharp contrast to the condition of godowns in PDF. In our previous survey (Brooks and Ahmad, 1986a), structure condition in Punjab was noted as good in 64% of cases, fair in 22% and poor in 14%. Of course ages of structures have a direct bearing on their condition, as noted previously in Punjab (Brooks and Ahmad 1986a) but when the condition of the newer Punjab structure, those 10 years old or less, are compared with PASSCO structures. Punjab structures still have a higher frequency of structural defects (Table 4).

A comparison was made between structural defects in godown (up to 10 years) in PDF and PASSCO (Fig. 2). PDF had many more structural defects (averaging 1.41/godown) than did PASSCO (averaging 0.5/godown). The higher frequency of defective walls, floors, doors and windows in PDF godowns permit easy entries for vertebrate pests.

TABLE IV.- STRUCTURAL CONDITION OF PASSCO (PRESENT STUDY) AND PDF (BROOKS AND AHMAD 1986A) GODOWNS

Age	PASSCO			PDF		
	Good	Fair	Poor	Good	Fair	Poor
Upto 4 Years	5	-	-	46	4	3
5 - 6 Years	2	-	-	18	7	4
7 - 8 Years	26	1	-	9	1	3
9 - 10 Years	17	5	-	10	3	3
Total	50	6	-	83	15	13

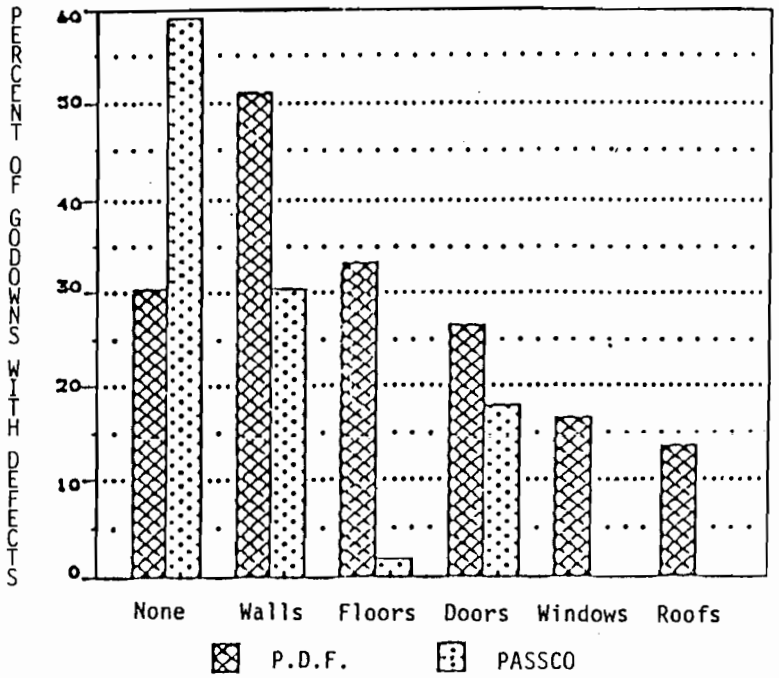

FIG. 2. Comparison of structural defects PDF v.s PASSCO.

Vertebrate Pest Infestations

PASSCO godowns had less rodent infestations inside (4 out of 56, 7.1%) than the PDF (50 out of 194, 25.8%). There was no evidence of desert jird

(*Meriones hurrianae*) or striped squirrel (*Funambulus pennanti*) or other vertebrates in PASSCO godowns as previously reported in PDF godowns (Brooks and Ahmad 1986a, b). These low rodent infestations indicate that the PASSCO-designed godown with rodent-guard, together with improved structure maintenance and good management, are effective in keeping rodents and other mammalian pests at a minimum in godowns.

Pest birds are another problem easily solved using proper building maintenance and good storage practices such as prevention of spillage or prompt clean-up of spills. Bird infestations were seen at 21 of the 56 godowns (37.4%) but all were graded as "few". In PDF survey, we noted bird infestations at 118 out of 194 godowns (60.8%) where 99 were graded "few", 17 as "medium" and 2 as "severe". Window and door defects were found in 127 PDF godowns. The fact that window and door defects were minimal at PASSCO sites where only 10 godowns had defective doors while none had defective windows, may have some bearing on the low frequency and lack of severity of birds problems of PASSCO facilities.

B. *Outdoor Storage*

Vertebrate pest infestations at outdoor storage sites were much greater than that seen at indoor storage. Rodent infestations become much more frequent and the number of species of field rats and mice attracted to grain stacks increases sharply. The Indian gerbil was the most frequently seen rat around outdoor storage sites, followed by house mice, desert jird and short-tailed mole rats. Where present, lesser bandicoot rats are important storage pests but they do not range into southern and western parts of Punjab Province (Roberts 1977, Beg and Khan 1984).

Even where rat species were found in abundance, burrow counts indicated that 25 to 50 animals were involved in damage to about 230 mt of wheat. Here, maximum losses might reach 0.2% of the total wheat in storage, rodents are probably of minor economic importance. However, rodent control measures are needed at some of the outdoor sites.

Pest birds were at all outdoor sites where wheat was stored. They were mainly feeding upon spilled grain leaking out from under the tarpaulins. They are primarily a nuisance in these situations and are not causing a significant economic impact. The pest control measures in outdoor plinths are almost same as for indoor storage i.e. the bags are covered with tarpaulin sheets and inspected twice a week. If insects appear, Actellic (pirimiphos methyl) is sprayed and sometimes the stocks are fumigated. No method is used in outdoor storage centres for rodent control.

CONCLUSIONS AND RECOMMENDATIONS

Well designed PASSCO godown structures with appropriate rat- guard, well-maintained structures and a technical staff trained in pest control methods, had minimal vertebrate pest infestations. This contrasted sharply with the conditions in PDF godowns which had higher infestation rates.

However, the policy of storing surplus wheat stocks outdoors on plinths leads to a high frequency of rodents and birds infestations. We recognize that this is an emergency procedure in a year of unusual wheat production and note that every effort was being made to distribute these stocks first.

Our main recommendation is that rodent control measures be initiated at all sites where grain stocks are to be stored outdoors, permanant bait stations can be made from 9 cm diameter. PVC pipe, cut into 40 cm lengths, placing after every 10 to 20 meters depending upon the infestation. Anticoagulant baits can be placed into the center of these station and rodents allowed to enter from either end. At least 250 gm of bait should be initially placed in each station and fresh bait added as needed. A good-quality grain bait, which includes 5% vegetable oil should be used to draw rodents away from the wheat stacks

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